Radiation Safety Check-Off List for Operation of Booster with Ions from EBIS and Tandem

(for operation beginning September 2015)

September 9, 2015

Prepared by: C.J. Gardner
Sign and Date: Chris J. Gardner 9/10/15
Reviewed by: D.R. Beavis
Sign and Date: Dana Beavis 9/10/15
Approved by: T. Roser
Sign and Date: Wolfram Fischer 9/10/15

Ions from EBIS and Tandem may be injected and accelerated in Booster **only upon completion of this check-off list**. Completion of this list **does not allow** for the injection of protons from Linac.

Before proceeding with the numbered check-off items, the **LTB**, **TTB**, and **ETB** Beamstops must be **Inserted, Locked, and Tagged**. If necessary, equivalent devices and/or procedures may be substituted with appropriate LP and RSC approval. The Beamstop Locks and Tags are as follows:

1. _____ (LPB) LOTO **Linac-To-Booster (LTB) Beamstop** Enable Key (in Building 914):

   Tag Number 6990 (placed on **LTB DH2–5 PS breaker**).

   Tag Number 5344 (placed on lock box containing **power supply kirk key** and Tag 6990).

   Lock Numbers 0753 and 16L136.

   Person/Date: Chris Gardner 1 September 2015

2. _____ (LPB) LOTO **Tandem-To-Booster (TTB) Beamstop** Enable Key (in Building 914):

   Tag Number 6988 (placed on **lock box** containing Chuck Carlson's LOTO of 2 Tandem beamstops).

   Lock Number 10L222

   Person/Date: Chris Gardner 28 July 2015

3. _____ (LPB) LOTO **EBIS-To-Booster (ETB) Beamstop** Enable Key (in Building 914):

   Tag Number 6989 (placed on **lock box** containing LOTO of Booster RF and main magnet).

   Lock Number 10L255

   Person/Date: Chris Gardner 28 July 2015

Note: The Lock and Tag prohibiting **proton injection from Linac** may not be removed until a radiation safety checkoff list for operation of Booster with protons from Linac is completed.

The following items are to be initialed as complete:

1 Security System

1. _____ (ACG) Functional Test of the Booster access control system complete.

2. _____ (ACG) Functional Test of Booster Extraction interlocks complete.

3. _____ (ACG) Functional Test of Booster-NSRL Penetration Stub interlocks complete. (These interlocks ensure that the stub region cannot be entered with beam in Booster.)

4. _____ (ACG) Functional Test of HEBT-TTB Cross-Over interlocks complete. (These interlocks ensure that this region cannot be entered with the TTB beamstops open.)

5. _____ (ACG) Booster Shutter to prevent long stored beam installed and operational. (The shutter is located in the B6 straight section downstream of the dump.)

6. _____ (ACG) B6 Dump cooling water flow-switch interlock operational. (This interlock closes the LTB, TTB, and ETB beam stops if water flow ceases.)

7. _____ (ACG) D3 Septum Magnet cooling water flow-switch interlock operational. (This interlock closes the LTB, TTB, and ETB beam stops if water flow ceases.)

8. _____ (RSCC) Active temporary changes or bypasses for Booster have been reviewed.

   _____ (ACG)

9. _____ (ACG) Orange tags on critical devices (LTB, TTB, and ETB beamstops) have been checked.

   _____ (LE) Orange tags appropriately located on devices.

2 Shielding

1. _____ (LE) The Booster berm shielding has been inspected.

   _____ (LPB)

2. _____ (LE) The inspections of the B6 soil cap and the cap at the interface of the Booster and NSRL are current.

3. _____ (LE) Booster F6 Septum shielding in place.

   _____ (LPB)

4. _____ (LE) Walk-through inspection of shielding inside Booster tunnel complete.

   _____ (LPB)

5. _____ (RSCC) Removal of sandbags near the Booster man-gate has been reviewed and approved.

6. _____ (LPA) Shielding on AGS side of common boundry between Booster and AGS inspected.

3 Fencing and Posting

1. _____ (LE) Booster Perimeter Fence in place.
   _____ (LPB)
2. _____ (RCD) Booster Perimeter Fence posted as a "Radiation Area".
3. _____ (LE) Building 914 roof security fence in place.
4. _____ (RCD) Building 914 roof security fence posted as a "Radiation Area".
5. _____ (LE) Security fence enclosing the area over the BTA line in place.
6. _____ (RCD) Security fence enclosing the area over the BTA line posted as a "Radiation Area" [1].
7. _____ (LE) Structure covering the three pipes that come through the Booster berm over C1 is in place.
8. _____ (RCD) The structure over C1 is posted as a "Radiation Barrier".
9. _____ (RCD) Building 914 posted as a "Radiation Area".
10. _____ (LE) Vent pipe gratings in the Booster tunnel in Place.
11. _____ (RCD) In the AGS ring, the Booster/AGS labyrinth must be posted on top as follows, to prohibit personnel from working on top of the labyrinth:

    "**WARNING! Working at shield top height prohibited, contact MCR if access is necessary.**"
12. _____ (RCD) The gate at the downstream end of NSRL Zone 3 (also known as the Booster-NSRL penetration stub) posted as a "High Radiation Area with Beam in Booster" (with instructions to contact MCR for beam status).
13. _____ (RCD) NSRL Zone 2 posted.

14. _____ (LE) Fence in place to prevent entry onto the Booster berm from the stairs at the downstream end of the Linac Building.

    _____ (LPB)

15. _____ (RCD) This fence (above) posted as a "Radiation Area".

4 Chipmunks

1. _____ (ACIG) Chipmunk NM060 on top of Building 914 plug door installed and checkout complete. This chipmunk is set to alarm at 10 and interlock at 20 mr/hour [1].

2. _____ (ACIG) Chipmunk NM058 in "Radiation Area" on Booster berm over F6 Septum installed and checkout complete. This chipmunk is set to alarm at 40 and interlock at 50 mr/hour [1].

3. _____ (ACIG) Chipmunk NM059 in "Radiation Area" on Booster berm over BTA DH2 & 3 installed and checkout complete. This chipmunk is set to alarm at 40 and interlock at 50 mr/hour [1].

4. _____ (ACIG) Chipmunks NM133 and NM134 in the Booster-NSRL Penetration Stub are installed and checkout complete. The chipmunk at the penetration headwall (NM134) is set to alarm at 16 and interlock at 20 mr/hour. The chipmunk at the stub gate (NM133) is set to alarm at 1 and interlock at 20 mr/hour. (Note that these chipmunks are disabled when extraction from Booster to NSRL is permitted.)

5. _____ (ACIG) All chipmunks are within their allowed calibration periods.

6. _____ (LPB) Location of above chipmunks checked.

5 Booster Extraction to AGS

1. _____ (LPB) Red Radiation Security Hold Tags have been applied to BTA QV5 power supply and magnet to ensure that the polarity of this quadrupole is not changed. (The quadrupole is wired to be vertically focussing for particles with positive charge).

Either Item 2 OR Item 3 must be completed:

2. _____ (LPA) The AGS is ready to accept beam.

OR

3. _____ (LPA) Booster Extraction to AGS is LOTO:

   Tag No. _____

   Lock No. _____

   Person/Date: _____

6 Booster Extraction to NSRL

Either Item 1 OR Item 2 must be completed:

1. _____ (LPN) NSRL (R-line) is ready to accept beam.

OR

2. _____ (LPN) Booster Extraction to NSRL is LOTO:

   Tag No. _____

   Lock No. _____

   Person/Date: _____

7 Sweeps

1. _____ (MCR) Area over BTA swept and locked.
2. _____ (MCR) Booster Berm swept and locked.
3. _____ (MCR) Booster swept and locked.

8 Verification and Permission

All of the above check-off items have been initialed as complete.

_____ (OC)

_____ (Date/Time)

The RS LOTO(s) that prevent EBIS and Tandem Ion beams from entering Booster may be removed. The **ETB** and **TTB** beamstop remote enable keys (in Bldg. 914) may be inserted and turned (or equivalent devices enabled) to allow beam enable from the MCR.

_____ (LPB)

_____ (Date/Time)

Abbreviations

LPA = Liaison Physicist AGS (**Haixin Huang** or designee)

LPB = Liaison Physicist Booster (**Chris Gardner** or designee)

LPN = Liaison Physicist NSRL (**Adam Rusek** or designee)

LE = Liaison Engineer (**George Mahler** or designee)

CME = Chief Mechanical Engineer, ME (**Joe Tuozzolo** or designee)

RSC = Radiation Safety Committee (**Dana Beavis** or designee)

RSCC = Radiation Safety Committee Chairman (**Dana Beavis**)

ACG = Access Control Group (**Jonathan Reich** or designee)

RCD = Radiation Control Division (**Paul Bergh** or designee)

ACIG = Accelerator Components and Instrumentation Group (**Tony Curcio** or designee)

MCR = Main Control Room

OC = Operations Coordinator

References

[1] D. Beavis, "Radiation at Booster High Radiation Areas", C-A Department Memo, June 2, 2015

[2] D. Beavis, "Minutes of RSC Subcommittee of May 6, 2015", Issued June 17, 2015.